

DIVISION 11

SECTION 3111F - ELECTRICAL SYSTEMS

3111F.1 General. This Section provides minimum standards for electrical systems at marine oil terminals.

Electrical systems include the incoming electrical service and components, the electrical distribution system, branch circuit cables and the connections. Also included are:

1. Lighting, for operations, security and navigation
2. Controls for mechanical and electrical equipment
3. Supervision and instrumentation systems for mechanical and electrical equipment
4. Grounding and bonding
5. Corrosion protection through cathodic protection
6. Communications and data handling systems
7. Fire detection systems
8. Fire alarm systems
9. Emergency shutdown systems (ESD)

All electrical systems shall conform to API RP 540 [11.1] and the National Electrical Code (NEC) [11.2].

See subsection 3101F.3 for definitions of "new" (N) and "existing" (E).

3111F.2 Hazardous area designations and plans (N/E). Area classifications shall be determined in accordance with API RP 500 [11.3], API RP 540 [11.1] and the NEC, Articles 500, 501, 504, 505, and 515 [11.2]. A marine oil terminal shall have a current set of scaled plan drawings, with clearly designated areas showing the hazard class, division and group. The plan view shall be supplemented with sections, elevations and details to clearly delineate the area classification at all elevations starting from low water level. The drawings shall be certified by a professional electrical engineer. The plans shall be reviewed, and revised when modifications to the structure, product or equipment change hazardous area identifications or boundaries.

3111F.3 Identification and Tagging. All electrical equipment, cables, conductors shall be clearly identified by means of tags, plates, color coding or other effective means to facilitate troubleshooting and improve safety, and shall conform to the identification carried out for the adjacent on-shore facilities (N). Topics for such identification are found in the NEC Articles 110, 200, 210, 230, 384, 480, and 504 [11.2]. Existing electrical equipment (E) shall be tagged.

Where identification is necessary for the proper and safe operation of the equipment, the marking shall be clearly visible and illuminated (N/E). A coded identification system shall apply to all circuits, carrying low or high voltage power, control, supervisory or communication (N).

3111F.4 Purged or Pressurized Equipment In Hazardous Locations (N/E). Purged or pressurized enclosures shall be capable of preventing the entry of combustible gases into such spaces, in accordance with NFPA – 496 [11.4]. Special emphasis shall be placed on reliability and ease of operation. The pressurizing equipment shall be electrically monitored and alarms shall be provided to indicate failure of the pressurizing or purging systems.

3111F.5 Electrical Service. Where critical circuits are used for spill prevention, fire control or life safety, an alternative service derived from a separate source and conduit system, shall be located at a safe distance from the main power service. A separate feeder from a double-ended substation or other source backed up by emergency generators will meet this requirement. An uninterrupted power service (UPS) shall be provided for control and supervisory circuits associated with ESD systems (N).

1. Electrical, instrument, and control systems used to activate equipment needed to control a fire or mitigate its consequences shall be protected from fire and remain operable for 15 minutes in a 2000° F fire, unless designed to fail-safe during fire exposure. The temperature around these critical components shall not exceed 200° F during 15 minutes of fire exposure (N).
2. Wiring in fireproofed conduits shall be derated 15% to account for heat buildup during normal operation. Type MI (mineral insulated, metal sheathed [11.2]) cables may be used in lieu of fireproofing of wiring (N).
3. Emergency cables and conductors shall be located where they are protected from damage caused by traffic, corrosion or other sources (N).
4. Allowance shall be made for electrical faults, overvoltages and other abnormalities (N).

Where solid state motor controls are used for starting and speed control, corrective measures shall be incorporated for mitigating the possible generation of harmonic currents that may affect the ESD or other critical systems (N).

3111F.6 Grounding and Bonding (N/E).

4. All electrical equipment shall be effectively grounded as per NEC Article 250 [11.2]. All non-current carrying metallic equipment, structures, piping and other elements shall also be effectively grounded.
2. Grounding shall be considered in any active corrosion protection system for on-shore piping, submerged support structures or other systems. Insulation barriers, including flanges or non-conducting hoses shall be used to isolate cathodic protection systems from other electrical/static sources. None of these systems shall be compromised by grounding or bonding arrangements that may interconnect the corrosion protection systems or interfere with them in any way that would reduce their effectiveness.
3. Bonding of vessels to the MOT structure is not permitted (2 CCR 2341 (f)) [11.5].
4. Whenever flanges of pipelines with cathodic protection are to be opened for repair or other work, the flanges shall be bonded prior to separation.
5. Direct wiring to ground shall be provided from all towers, loading arms or other high structures that are susceptible to lightning surges or strikes.

3111F.7 Equipment Specifications (N). All electrical systems and components shall conform to National Electrical Manufacturers Association (NEMA) standards or be certified by a Nationally Recognized Testing Laboratory (NRTL).

3111F.8 Illumination (N/E). Lighting shall conform to 2 CCR 2365 [11.6] and 33 CFR 154.570 (d) [11.7].

3111F.9 Communications and Control Systems.

3111F.9.1 Communication Systems (N/E). Communications systems shall comply with 2 CCR 2370 [11.8], and conform to Section 6 of [11.9].

3111F.9.2 Overfill Monitoring and Controls (N/E). Overfill protection systems shall conform to Appendix C of API RP 2350 [11.10]. These systems shall be tested before each transfer operation or monthly, whichever is less frequent. Where vessel or barge overfill sensors and alarms are provided, they shall comply with 33 CFR 154.812 [11.11].

All sumps shall be provided with level sensing devices to initiate an alarm to alert the operator at the approach of a high level condition. A second alarm shall be initiated at a high-high level to alert the operator. Unless gravity drainage is provided, sumps must have an automatic pump, programmed to start at a pre-determined safe level.

3111F.10 Corrosion Protection.

3111F.10.1 Corrosion Assessment (N). An assessment shall be performed to determine the existing and potential corrosion. This assessment should include all steel or metallic components, including the structure, pipelines, supports or other ancillary equipment, with drawings and specifications for corrosion prevention/protection. The assessment shall be performed by a licensed professional engineer, using the methods and criteria prescribed in [11.12].

3111F.10.2 Inspection, Testing and Records (N/E). For sacrificial anode systems, periodic underwater inspections shall be performed and observations recorded. For impressed current systems, monthly rectifier readings and annual potential readings of the protected components shall be taken. If potential readings for steel structures are outside of acceptable limits (between -0.85 [11.13] and -1.10 Volts), corrective actions shall be taken. Voltage drops other than across the structure-to-electrolyte boundary must be considered for valid interpretations of potential measurement. Consideration is understood to mean the application of sound engineering practice in determining the significance of voltage drops by methods such as:

1. Measuring or calculating voltage drop(s)
2. Reviewing historical performance of the Cathodic Protection System (CPS)
3. Evaluating the physical and electrical characteristics of the structure and the environment
4. Determining whether or not there is physical evidence of corrosion

All isolating sections shall be tested immediately after installation or replacement, and, at a minimum, annually. Test results shall be recorded and documented. Electrical tests on insulating flanges shall make use of specialized insulator testers. The test instrument shall make use of RF signals, capacitive measurements or other means to clearly determine whether an insulating flange is shorted or open circuited without being affected by pipe-to-soil potentials, cathodic protection voltages or whether it is buried or exposed.

The cathodic protection inspection for buried or submerged pipelines shall conform to API 570 [11.14].

Insulating and isolating arrangements for protection against static, stray and impressed currents shall be tested in accordance with 2 CCR 2341(d) and 2380 [11.15].

3111F.11 References

- [11.1] American Petroleum Institute, 1999, *API Recommended Practice 540 (API RP 540)*, "Electrical Installations in Petroleum Processing Plants," 4th ed., Washington, D.C.
- [11.2] National Fire Protection Association, 2002, *NFPA 70, "National Electric Code (NEC)"*, Quincy, MA.
- [11.3] American Petroleum Institute, 1997, *API Recommended Practice 500 (API RP 500)*, "Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2," 2nd ed., Washington, D.C.
- [11.4] National Fire Protection Association, 1998, *NFPA 496, "Standard for Purged and Pressurized Enclosures for Electrical Equipment"*, Quincy, MA.
- [11.5] 2 CCR 2341(f), Title 2, California Code of regulations, Section 2341(f).
- [11.6] 2 CCR 2365, Title 2 California Code of Regulations, Section 2365.
- [11.7] 33 CFR 154.570(d), Title 33 Code of Federal Regulations Section 154.570(d).
- [11.8] 2 CCR 2370, Title 2 California Code of Regulations, Section 2370.
- [11.9] Oil Companies International Marine Forum (OCIMF), 1987, "Guide on Marine Terminal Fire Protection and Emergency Evacuation," 1st ed., Witherby, London.
- [11.10] American Petroleum Institute, 1996, *API Recommended Practice 2350 (API RP 2350)*, "Overfill Protection for Storage Tanks," 2nd ed., Washington, D.C.
- [11.11] 33 CFR 154.812, Title 33, Code of Federal Regulations, Section 154.812 - Facility Requirements for Vessel Liquid Overfill Protection.
- [11.12] National Association of Corrosion Engineers (NACE), *Standard Recommended Practice*, 1994, RP0176-1994 "Corrosion Control of Steel Fixed Offshore Platforms Associated with Petroleum Production," Houston, TX.
- [11.13] Department of Defense, 31 January 1990, *Military Handbook, "Electrical Engineering Cathodic Protection"*, MIL-HDBK-1004/10, Washington, D.C.
- [11.14] American Petroleum Institute, 2002, *API 570, "Piping Inspection Code"*, 2nd ed., October 1998 (February 2000 Addendum 1), Washington, D.C.
- [11.15] 2 CCR 2341(d) and 2380, Title 2, California Code of Regulations, Sections 2341(d) and 2380.
- Authority: Sections 8755 and 8757, Public Resources Code.
- Reference: Sections 8750, 8751, 8755 and 8757, Public Resources Code.